

# **Shaken Baby Syndrome: Medico-Legal Miscommunication and the Derailing of Science**

April 2014

Susan E. Luttner

Technical writer and editor, Palo Alto, California

## **Keywords:**

Shaken baby syndrome, abusive head trauma, inflicted head trauma, exoneration, wrongful conviction, evidence based medicine

## **Biographical Note:**

Susan Luttner is a technical writer and editor who became interested in shaken baby syndrome in the 1990s when the niece of a friend was accused and ultimately convicted of child abuse for a presumed shaking assault. She has been following the medical literature and attending the shaken baby conferences since 1998.

## **Abstract:**

This paper tracks the evolving medical literature on shaken baby syndrome/abusive head trauma and reviews the milestone court cases, illustrating how the two have influenced each other. The author argues that current child-protection policies have turned an untested medical hypothesis into a nearly unstoppable courtroom force. Parents of children with legitimate medical conditions are being targeted as abusers, and their children are denied the treatment they need, while child-protection resources are diverted to cases that are easy to argue in court but destructive to families and justice.

## **Introduction**

For nearly 40 years, prosecutors have been winning convictions on charges ranging from child endangerment to murder based on the hypothesis of Shaken Baby Syndrome (SBS) (Committee 1993), recently renamed Abusive Head Trauma (AHT) (Christian 2009). Doctors who accept the hypothesis believe that a pattern of bleeding and swelling inside the infant skull proves that the child has suffered a physical assault, even if the child has no bruises, abrasions, grip marks, or other external signs of battering.

SBS has proved potent in the courtroom because it includes two assumptions: The brain findings cannot be produced by anything except violent trauma, and the effects of that trauma will be immediately apparent (Chadwick 1998).

Accumulated experience has now shown both of these assumptions to be false (Sutherly 2005, Avril 2007, Huntington 2002, Ruelas 2012, Brammer 2013, National Registry 2014), but convicted caretakers remain convicted, shattered families remain shattered, and, tragically, the prosecutions continue.

### **Historical Perspective**

Although the foundations had been laid earlier (Caffey 1946), child abuse as a medical diagnosis hit the U.S. in the early 1960s with the publication of Dr. C. Henry Kempe's call to action, "The Battered-Child Syndrome" (Kempe, 1962), which triggered today's mandated-reporting laws for medical and educational professionals. The subspecialty of child abuse pediatrics was added to the medical-board exams just a few years ago (Giardino 2011).

Under Kempe's guidelines, doctors began looking carefully for signs of abuse and soon noticed that children they believed to be battered often had retinal hemorrhages (RH, bleeding in the backs of the eyes) (Gilkes 1967); some physicians came to believe RH occurred only in cases of abuse (Eisenbrey 1979). Subdural hematoma (SDH, bleeding between the outer two layers of the meninges, the 3-ply membrane that encases the brain and spinal fluid) was historically associated with birth, impact injury, and meningeal infection (Guthkelch 1953). In 1971, pediatric neurosurgery pioneer Dr. A. Norman Guthkelch in Britain proposed that shaking an infant could cause subdural bleeding without direct impact to the head (Guthkelch 1971). A later paper in the U.S. by pediatric radiologist Dr. John Caffey popularized the proposition (Caffey 1972), which was adopted on both sides of the Atlantic (Ludwig 1984, Carty 1995).

Guthkelch had focused on SDH in the absence of impact injuries. Caffey first proposed that shaking would cause SDH, RH, and fractures of the long bones, adding cerebral edema later (Caffey 1974). "Cerebral edema" is essentially "brain swelling," although there is a medical distinction between excess fluid within the cells and excess fluid in the intercellular spaces.

The observation below in a 1984 paper illustrates that doctors had begun to believe that SDH, especially in the gap between the two hemispheres of the brain, resulted only from a violent event:

Our findings indicate that the young infant manifesting respiratory alterations in the face of a normal pulmonary examination may have been shaken... The physical findings of tense or bulging fontanelle, head circumference greater than 90<sup>th</sup> percentile for age, and retinal hemorrhage strengthen the diagnosis... Computer cranial tomography may specifically confirm SBS by showing acute interhemispheric subdural hematoma or cerebral contusion in the absence of external trauma. (Ludwig 1984)

A 1993 review assembled a definition of SBS much like that often used in court today:

The full picture... comprises subdural haematoma, massive cerebral oedema, haemorrhagic retinopathy, fractured ribs and metaphyseal injury, but any combination of the above may occur. The classical picture occurs without any skull fracture, bruising of the scalp, oedema or evidence of direct head trauma. (Brown 1993)

“Metaphyseal injury” means a lesion at one edge of a bone’s growth plate, thought by Kempe to result only from abuse (Kempe 1962).

Once doctors started interpreting SDH and RH as certain signs of trauma, the literature exploded with observational studies and case reports. By the turn of the century, hundreds of doctors in various specialties had published their efforts to learn more about the syndrome by studying the babies they treated or examined who had been diagnosed as shaken, based on the model of infant head injury then being taught at conferences and in medical schools (Block 1999).

While the diagnosis was gaining acceptance in the field, however, biomechanical research had started raising doubts. In 1987 the Duhaime team reported their findings that shaking by a normal adult does not generate the forces thought necessary to trigger concussion, SDH, or damage to brain cells from shearing or stretching (Duhaime 1987). Noting that angular accelerations spiked when volunteers were told to throw the test mannequin down after shaking, the authors concluded:

Although shaking may, in fact, be a part of the process, it is more likely that such infants suffer blunt impact. The most common scenario may be a child who is shaken, then thrown into or against a crib or other surface, striking the back of the head and thus undergoing a large, brief deceleration. (Duhaime 1987)

This research entered the conversation but had little effect on the thinking of most practitioners. Even in cases with signs of impact, in fact, doctors often conclude that SDH and RH indicate the child was shaken as well as slammed (Brown 1993, Shapiro 2012, National Registry 2014).

Complicating the situation further, child-abuse experts teach that children seldom if ever receive fatal injuries in short falls, even falls down stairs (Joffe 1988, Chadwick 1991, Lyons 1993, Chadwick 2008). Further discussion is outside the scope of this paper, but other reports refute this conclusion (Hall 1989, Denton 2003, Lantz 2011), including a fatal fall caught on videotape in which a toddler rolled off a post she was straddling, with her feet 24 inches off the floor (Plunkett 2001). Similarly, recent research has acknowledged various

non-traumatic causes of RH (Agrawal 2012) and SDH (Squier 2009) and non-abusive causes of interhemispheric subdurals (Tung 2006), and bone development is a more complex process than previously understood (Seeman 2006).

### **Timing of the Injuries**

The first formal statements about SBS emphasized the murkiness of the condition and cited slowly evolving symptoms. In 1993, the American Academy of Pediatrics wrote:

Shaken baby syndrome is characterized as much by what is obscure or subtle as by what is immediately clinically identifiable. A shaken infant may suffer only mild ocular or cerebral trauma. The infant may have a history of poor feeding, vomiting, lethargy, and/or irritability occurring intermittently for days or weeks prior to the time of initial health care contact. The subtle symptoms are often minimized by physicians or attributed to mild viral illnesses, feeding dysfunction, or infant colic. (Committee 1993)

And in Britain:

After a variable time, the infant will develop signs of cerebral irritation, cerebral oedema, or intracranial haemorrhage. Acute deterioration, convulsions, or respiratory or circulatory arrest may follow. (Carty 1995)

Physicians have recognized for centuries that a person might suffer a serious head injury followed by a “lucid interval,” a period of time when the patient appears to be normal, only to collapse later, after pressure inside the skull has built to debilitating levels. Child abuse doctors, however, often teach that symptoms of a head injury are always immediate in a baby. A leading textbook in 1994, for example, argued that the infant’s immature brain reacts differently to trauma and offered this guideline, with no literature citations:

Despite its frequency, deaths (sic) related to head trauma in infancy remain the most difficult to prosecute for two reasons: (1) lethal head trauma in infants is often produced without external evidence of injury, leading to speculation about mysterious natural causes or trivial accidental injury; and (2) many clinicians and pathologists equivocate about the timing of the lethal event because they are uncertain of the immediate relationship between the injury and its effect on the brain. It is best, therefore, to state immediately two axioms regarding fatal head trauma in infants:

1. Trivial events (i.e., falls from beds, couches, against coffee tables, etc.) produce trivial injuries; significant events (blows, shaking, forced impact) produce potentially lethal injuries.
2. Lethal injuries produce progressively more severe symptoms almost immediately; no significant “lucid” or asymptomatic period occurs. (Kirschner 1994)

In an early review of the literature for guidance about timing, Nashelsky and Dix found only three published cases of pure shaking with no signs of impact:

In two cases, there was onset of symptoms immediately after shaking. In one case, there was a delay of 4 days between shaking and onset of seizures although the child had several episodes of vomiting during the days after shaking. One wonders whether the infant was reshaken shortly before onset of seizure activity (Nashelsky 1995)

The opinion of the authors aside, this seems to be a report of a lucid interval following a shaking injury.

Researchers at a San Diego children’s hospital tried to extrapolate timing from accidental injury. They identified 95 witnessed, fatal accidental injuries to children younger than 16 years—4 of them under the age of 2—almost all of them from motor vehicle accidents (Willman 1997). The researchers looked only at cases where an emergency response team was sent to the scene. They tracked each child’s level of consciousness, starting with the assessments by the EMTs in the field. The only children who seemed to deteriorate after medical contact suffered from growing epidural hematomas (bleeding between the dura and the skull), so the authors concluded:

Unless an epidural hematoma is present, children who die of blunt head injuries probably do not experience lucid intervals. In cases of fatal HI [head injury] where the history claims that the child looked well following the injury and only later began to act abnormal, the story must be questioned and nonaccidental trauma must be suspected. (Willman 1997)

The next year, however, forensic pathologist Dr. M.G.F. Gilliland published her observations based on the medical records of 76 fatal pediatric head-injury cases collected from her own and her colleagues’ experiences. A quarter of Gilliland’s cases featured a time lag between the trauma and an obvious deterioration in consciousness, with a definition of “brief” that differed significantly from Willman’s:

Our data indicate that the interval is brief (less than 24 hours), in almost 3/4 of cases of head injury death, especially in shaking injuries. However, in more than 1/4 of the cases, the interval from injury to the onset of

severe symptoms is longer. In all cases in which the children were seen by an independent observer after injury, they were described as not normal. (Gilliland 1998)

At that time, the medical literature contained at least two case reports of catastrophic infant head injuries with delayed symptoms (Frank 1985, Nashelsky 1995).

### **Louise Woodward**

Shaken baby syndrome hit the headlines in 1997, when “Boston nanny” Louise Woodward was accused of shaking to death 8-month-old Matthew Eappen. Like many children in shaking cases, Matthew had a skull fracture that could not be dated. He also had a healing wrist fracture that no one could explain and a fatal brain injury.

Prosecution experts testified that Matthew’s brain injury proved he had been shaken immediately before losing consciousness. The defense doctors argued that the boy suffered from an older brain injury that had started rebleeding while he was in the nanny’s care. To dispute the shaking diagnosis, the defense also called Prof. Lawrence Thibault, the biomechanical engineer who had designed the mannequins for the Duhaime research, and Dr. Ayoub Ommaya, whose early biomechanical results Duhaime relied on for her analysis (Ommaya 1984).

After a televised trial, the jury convicted Woodward, but then Judge Hiller Zobel reduced the charges to manslaughter and set the sentence to time served. Woodward returned to England, to something of a heroine’s welcome (Lyall 1997).

Unhappy with the murky outcome, several dozen child abuse doctors published a statement dismissing the Woodward defense and decrying media coverage that treated it as credible. The doctors articulated their faith in both immediate symptoms and the reliability of three findings as proof of SBS:

Infants simply do not suffer massive head injury, show no significant symptoms for days, then suddenly collapse and die. Whatever injuries Matthew Eappen may or may not have suffered at some earlier date, when he presented to the hospital in extremis he was suffering from proximately inflicted head injuries that were incompatible with any period of normal behavior subsequent to the injury. Such an injury would and did produce rapidly progressive, if not immediate, loss of consciousness.

The shaken baby syndrome (with or without evidence of impact) is now a well-characterized clinical and pathological entity with

diagnostic features in severe cases virtually unique to this type of injury—swelling of the brain (cerebral edema) secondary to severe brain injury, bleeding within the head (subdural hemorrhage), and bleeding in the interior linings of the eyes (retinal hemorrhages). Let those who would challenge the specificity of these diagnostic features first do so in the peer-reviewed literature, before speculating on other causes in court. (Chadwick 1998)

Forensic pathologist John Plunkett rose to the challenge. His response criticized testimony at the Woodward trial that the force necessary to cause the child's injuries would be equivalent to a fall from a two-story building or a car crash (Plunkett 1999), and he contested immediate symptoms, as he had previously in a response to the Willman paper (Plunkett 1998).

Also unsatisfied by the Woodward outcome was a handful of pioneers in the field of biomechanics, including Prof. Werner Goldsmith at Berkeley, who had devoted the last portion of a long and prolific career to studying helmet design, for which he focused on head and neck injuries. Drawn in by colleagues politicized by Woodward, Goldsmith collaborated with Dr. Ommaya and Prof. Thibault on their final paper, a biomechanical critique dismissing shaken baby syndrome (Ommaya 2002). Later, a former student of Ommaya's published an analysis explaining his conclusion that an infant's neck would break from a shaking assault before the forces would be great enough to trigger subdural bleeding (Bandak 2005). Critics of Bandak's work say he has made a miscalculation (Margulies 2006, Rangarajan 2006), but Bandak disputes their analysis (Bandak 2006), and another commentator observes that even if Bandak made the alleged miscalculation, his point remains valid (Molina 2009).

A number of other biomechanical researchers have revisited the Duhaime study. Most have replicated her results (Prange 2003, Cory 2004, Lloyd 2011), although one team has achieved angular accelerations more compatible with shaking as a mechanism (Jenny 2002, Jenny 2005).

In 2001, the American Academy of Pediatrics updated its SBS position statement, taking a half-step back from the slowly evolving symptoms described in 1993. Combining old language with new, the statement said that parents would be immediately aware that their baby was behaving differently, although a doctor might not recognize a head injury:

A victim of sublethal shaking may have a history of poor feeding, vomiting, lethargy, and/or irritability occurring for days or weeks. These clinical signs of shaken baby syndrome are immediately identifiable as problematic, even to parents who are not medically knowledgeable (19). However, depending on the severity of clinical signs, this may or may not result in caretakers seeking medical attention. These nonspecific signs are often minimized by physicians or

attributed to viral illness, feeding dysfunction, or colic. (Committee 2001)

Footnote 19 is a survey article that extrapolates the timing of inflicted injuries from the primate research, the Willman paper, and a study in which children under 2 years old were 4.1 percent of the eligible population, 2 percent of the study group (Snoek 1984) to reach this conclusion:

Thus, an alert, well-appearing child has not already sustained a devastating acute injury that will become clinically obvious hours to days later. (Duhaime 1998)

Also in 2001, the National Association of Medical Examiners (NAME) released a committee statement that offered this description of assaultive head injuries:

The mechanism of injury produced by inflicted head injuries in these children is most often rotational movements of the brain within the cranial cavity. Rotational movement of the brain damages the nervous system by creating shearing forces, which cause diffuse axonal injury with disruption of axons and tearing of bridging veins, which causes subdural and subarachnoid hemorrhages, and is very commonly associated with retinal schisis and hemorrhages. . . . The pathologic findings of subdural hemorrhage, subarachnoid hemorrhage and retinal hemorrhages are offered as “markers” to assist in the recognition of the presence of shearing brain injury in young children. (Case 2001)

This definition does not mention cerebral edema but adds diffuse axonal injury (damage to neurons stretched or compacted beyond their physical limits rather than injured by a direct blow), one of the markers evaluated by the Duhaime team but not examined in the original primate research (Ommaya 1968) cited by Guthkelch in his seminal paper (Guthkelch 1971). “Subarachnoid hemorrhage” refers to bleeding underneath the arachnoid layer of the meninges, closer to the brain than subdural blood.

The 2001 NAME statement also argued that shearing of the neurons during the act of shaking would cause an immediate change in consciousness (Case 2001), a statement that triggered a third published case report of a lucid interval. Forensic Pathologist Dr. Huntington had autopsied a toddler who was brought to the hospital in the morning for ongoing vomiting. Hospital records described her as “fussy and clingy, but interactive and responsive,” and she was treated for gastrointestinal problems. The breathing difficulties began in the middle of the night, after she had spent more than 12 hours in the care of trained medical professionals, none of whom recognized the signs of an ultimately fatal brain injury (Huntington 2002).

The lead author of the statement responded that the girl was in fact showing the signs of her brain injury:

When a child has suffered a serious acceleration injury to the brain that will result in long-term neurologic impairment or cause death, the so-called lucid interval is a fiction. The change from “fine” to “not fine” may be lethargy or it may be unresponsiveness, but it is a neurologic change, and it occurs at the time of injury. (Case 2002)

A fourth case report soon followed, in which a 9-month-old collapsed on the third day after a reported fall from a bed (Denton 2003). The infant had been observed in the interim by his mother, his grandmother, and his babysitter, who knew about the fall and were looking for problems but had observed nothing alarming.

Finally, in 2005, researchers in Pennsylvania extracted cases of fatal head injuries in patients younger than 4 years from nearly two decades of state trauma records, and discovered that a small but positive number, about 2%, of children with ultimately fatal head injuries reached the emergency room with a score of 13-15 on the 15-point Glasgow Coma Scale (Arbogast 2005). Younger children were especially likely to appear normal at first medical contact.

In 2003, meanwhile, Dr. Mark Donohoe had applied the criteria of evidence-based medicine to the early SBS literature, identifying articles through a Medline search on the phrase “shaken baby syndrome” (Donohoe 2002). He concluded that the hypothesis had not been proven, noting that much of the literature consisted of

... opinions that shed no new light upon SBS and did not add to knowledge about SBS. Many of the authors repeated the logical flaw that if RH and SDH are almost always seen in SBS, the presence of RH and SDH “prove” that a baby was shaken intentionally...

Thus, the data available in the medical literature by the end of 1998 were inadequate to support any standard case definitions, or any standards for diagnostic assessment. (Donohoe 2003)

In fairness, setting up blinded experiments with valid control groups in this arena is challenging, because there is no objective standard for establishing that a child has been abused. Still, the circular reasoning Donohoe identified continues in today’s literature. A 2004 attempt to identify the characteristics that distinguish abused children from children with accidental injury, for example, used the classification scheme reproduced in Figure 1 to sort cases into “inflicted” versus “accidental” injury.

**TABLE 1.** Classification Scheme

---

Inflicted head injury, clinical and radiological evidence of brain injury with:

- No history of traumatic event (fall, blow to head, motor vehicle crash) or
- History of traumatic event that is incompatible with developmental level or
- Witnessed inflicted head injury or
- Confession by alleged perpetrator to inflicting the head injury or
- Evidence of other physical injuries consistent only with inflicted injuries (eg, pattern bruises, occult rib or extremity fractures)

Accidental head injury, clinical and radiological evidence of brain injury with:

- History of traumatic injury that is corroborated by more than one adult or
- History of traumatic injury that is compatible with developmental level and
- Absence of any physical injuries that are consistent with inflicted injury (eg, pattern bruises, occult rib or extremity fractures)

---

Modified from Reece and Sege.<sup>5</sup>

Figure 1. Classification scheme from Bechtel 2004

Note that SDH with no history of a traumatic event is defined as “inflicted,” and there is no way this study could show otherwise. The resulting paper has since been incorporated into a number of meta-analyses that pool the data from a collection of similar studies (e.g., Maguire 2011, Piteau 2012).

Ten years later, Donohoe’s work continues to receive harsh criticism from child abuse experts (Greeley 2011, Holmgren 2013), but no one has yet identified the research that has established shaken baby syndrome as more than a hypothesis. Direct experimentation is unthinkable, obviously, and the occasional witnessed or videotaped shaking has yet to result in the symptoms now diagnosed as shaking injury (Luttner 2012).

Researchers in Britain also began raising questions about some of the neurological tenets of shaken baby syndrome. In 2001 neuropathologist Dr. Jennian Geddes concluded that much of the brain damage in these cases comes not from direct trauma but from a lack of oxygen to the tissues, as bleeding and swelling interfere with normal systems (Geddes 2001, parts I & II).

Working from a foundation laid by Geddes (Geddes 2003), neuropathologist Dr. Waney Squier and her colleagues proposed that the very thin subdural collections often seen in presumed shaking cases represent seepage of blood from the dura itself, rather than spillage from torn bridging veins (Squier 2009). Rejected at first, Squier’s proposed non-traumatic origin for thin-film subdurals is now gaining acceptance (Slovic 2012).

### **Audrey Edmunds**

The 2001 statement from the National Association of Medical Examiners (Case 2001) ultimately brought another highly contested case into the debate. Dr. Robert Huntington, who had responded with the letter documenting delayed symptoms in a hospital setting, had testified several years earlier in the trial of Audrey Edmunds, a care provider convicted of murder for the presumed shaking death of an infant. After his personal experience, Dr. Huntington knew he had been wrong when he told the Edmunds jury that the symptoms of a fatal pediatric head injury would be immediately obvious.

When they learned of Dr. Huntington's change of heart, law professor Keith Findley and his students at the Wisconsin Innocence Project began researching both the timing of the symptoms and the larger questions around shaken baby. They successfully reopened the Edmunds case, with the argument that opinion within the medical community had changed, and the consensus around SBS was dissolving. A state appeals court vacated Edmunds' conviction in 2008 (State v. Edmunds 2008).

The Edmunds decision attracted the attention of law professor Deborah Tuerkheimer, who followed up the footnotes in the appeal and reached the same conclusion as Findley's team: Not only had shaken baby syndrome never been proven, but biomechanical research and accumulated experience were both eroding its credibility (Tuerkheimer 2009, Tuerkheimer 2011). Her book on the topic is just out this spring (Tuerkheimer 2014).

In 2009, the American Academy of Pediatrics updated its position statement again, this time making no comment on timing but abandoning the term "Shaken Baby Syndrome" in favor of "Abusive Head Trauma," with this explanation:

Legal challenges to the term "shaken baby syndrome" can distract from the more important questions of accountability of the perpetrator and/or the safety of the victim. The goal of this policy statement is not to detract from shaking as a mechanism of AHT but to broaden the terminology to account for the multitude of primary and secondary injuries that result from AHT. (Christian 2009)

### **Shirley Ree Smith**

SBS resurfaced in the news in 2011, when the U.S. Supreme Court reinstated the 1997 conviction of grandmother Shirley Ree Smith, vacating a 2006 reversal by the Ninth Circuit Court of Appeals, which had declared the evidence against Smith "constitutionally insufficient." The Supreme Court's decision to reverse did not address the question of Smith's guilt or innocence, but turned on the court's opinion that the Ninth Circuit did not have the power to overrule the jury's decision (Cavazos v. Smith 2011). As in Woodward, the legal outcome supported the prosecution, but the defendant went free amid a whirl of

sympathetic publicity, this time after Governor Jerry Brown issued a pardon. The Smith decision also contained a strongly worded dissent written by Justice Ruth Bader Ginsberg, who cited some of the research casting doubt on shaken baby syndrome and noted that the child's symptom list (subdural hemorrhage, subarachnoid hemorrhage, and optic nerve sheath hemorrhage) did not match any known profile of the condition.

Again, the murky outcome irked the community of child abuse experts, who denounced the decision at conferences (Greeley 2012, Alexander 2012) and in print (Moreno 2013). "Despite all the ballyhoo, there has been no paradigm shift in the scientific support for the diagnosis of AHT/SBS," attorneys Moreno and Holmgren wrote, attributing the "false controversy" to scientists in it for the money:

... the outlier views expressed by defense medical witnesses and parroted in law review articles is self-validating (sic). The academics cite the same handful of defense medical witnesses, the media cites both, the defense medical witnesses benefit from the publicity and are hired in more cases, and the cycle begins anew. (Moreno 2013)

This presumed cadre of defense-witnesses-for-hire receives recurring grief and ridicule at shaken baby conferences: In 2010, in front of 600 people, a guitar-playing pediatrician led a karaoke-style sing-along with the chorus "If I only get ten grand" to the tune of "If I Only Had a Brain" from the *Wizard of Oz* (Holmgren 2010).

Speakers at that conference also characterized "the so-called triad" as a straw man invented by defense experts to make the diagnosis look overly simple. "Only people who are NOT active physicians working with children, naïve journalists, and professors with a biased agenda would propose that only three signs and symptoms support a diagnosis," declared Dr. Robert Block, at the time president pro tem of the American Academy of Pediatrics (Block 2010). Another frequent presenter at SBS/AHT conferences has recently published an editorial declaring the AHT controversy "fabricated," with this observation:

The complex features of AHT are often disparagingly distilling (sic) simply to "The Triad"; a term devoid of any real clinical meaning and not used at all in practice. (Greeley 2014)

For the first decade of SBS conferences, however, the "triad" was taught as a matter of course. From the executive summary published in 2001, for example, after the third conference:

As in prior conferences, a major focus of this conference was the constellation of injuries which are present in almost every shaken baby case, but which are rarely seen in any other accidental form of trauma

(sic). Often referred to as the “triad,” the consensus continues to be that a collection of (1) damage to the brain, evidenced by severe brain swelling and/or diffuse traumatic axonal injury; (2) bleeding under the membranes which cover the brain, usually subdural and/or subarachnoid bleeding; and, (3) bleeding in the layers of the retina, often accompanied by other ocular damage, when seen in young children or infants, is virtually diagnostic of severe, whiplash shaking of the head. (Parrish 2001)

And as mentioned earlier, dozens of child abuse experts signed a statement endorsing a triad—a more restrictive triad than Parrish’s, but the same one articulated in the *British Medical Journal* a few years later (Harding 2004)—after the Woodward sentencing (Chadwick 1998).

Meanwhile, a few families have been exonerated when further investigation established that their child’s symptoms were actually due to a medical condition, so far including metabolic disorder (Sutherly 2005), vitamin deficiency (Avril 2007), seizure disorder (Ruelas 2012), sickle cell disease (Thompson 2011), birth defect (Luttner 2011), accident (Shapiro 2012), and stroke (Candler 2013). The medical literature now contains a growing body of case reports and opinions about other conditions and mechanisms that can produce the same symptoms (Piatt 1999, Pittman 2003, Clemetson 2004, Orient 2005, Talbert 2005, Talbert 2009, Barnes 2010, Stray-Pedersen 2010, Barnes 2011, Squier 2011, Talbert 2012, De Leeuw 2013, Scheimberg 2013). The recent editorial dismissing “The Triad” as a defense construct also criticizes papers like these as “unsupported and fringe theories... created not with a clinical gap to fill, but explicitly to be used in court” (Greeley 2014).

Clearly, the critics of the SBS hypothesis and the proponents of the SBS hypothesis are not communicating effectively. At the root of this problem is a child-protection system designed and implemented with the assumption that the doctors are always right, which has left the doctors with the impression that it’s true.

Child-protection laws mandate that medical and educational professionals report any suspicion of child abuse, to be investigated by the proper authorities. There are no sanctions for a mistaken report, but there are sanctions for a mandated reporter who sees signs of abuse and fails to act.

In an effort to meet their mandated duties, hospitals have started coordinating their efforts with the state through “child protection teams,” which bring together law enforcement, social workers, and physicians from a range of specialties (beginning with radiology, ophthalmology, and child abuse pediatrics), usually on hospital premises.

This arrangement short-circuits the investigation, however, when a report of suspected abuse comes from the hospital itself. When the doctors say they are sure a child has been assaulted, and they can say when the assault took place, both social services and law enforcement leap into action: Social workers remove all children from contact with the presumed abuser and pressure other family members to accept the diagnosis, heedless of the financial and emotional consequences (Barry 2014), and the police begin building a case against the caretaker who was on the scene when the seizures and breathing problems started.

Confident they can identify the perpetrator of a horrific crime, police might employ high-pressure, confrontational tactics on parents who are already emotional and confused because their child is critically ill (Virtanen 2014, Boeri 2011).

Faced with a growing chorus of critics and scant biomechanical evidence to support their model, proponents of the shaken baby syndrome hypothesis are now relying on their own clinical experience (Gill 2009) and confessions (Adamsbaum 2010) to validate their opinions. But while confessions might help support the proposition that shaking an infant can cause brain bleeding and swelling, it does nothing to establish that the symptoms always result from assault.

## **Conclusion**

This paper is not arguing that shaking a baby is safe, or that infants do not suffer terrible injuries at the hands of parents and caretakers. It is pointing out that social services, police, and prosecutors have taken their cues directly from the child abuse physicians on the subject of infant head injury, while the individual families affected by the diagnosis of infant shaking have been flattened by a united force against them.

The doctors who have dedicated their lives to fighting child abuse are doing their work diligently, but they are not infallible, and the pressures of the courtroom have encouraged them to take black-and-white positions on complex medical questions, which is always a dangerous path, especially in an emotional arena.

The prosecution in these cases has the full power of the state on its side, as well as the star witnesses. The accused parents usually have no medical knowledge and nowhere near the resources necessary to hire an effective defense team for a trial that hinges on expert testimony. How do you prove you didn't shake your baby?

The physicians who have seen their opinions confirmed by decades of trial outcome now believe that their model of infant head injury has been proven.

The problem is that the scientific debate has been distorted through the lens of a legal system unable to distinguish between sincere medical opinion and established scientific truth. The challenge ahead is how to unravel three decades of unreliable convictions, and how to restructure child protection policies to stop the bulldozer.

*With thanks to Nicole Myerscough and Carter Quinby for invaluable support during the researching and revising of this manuscript.*

Adamsbaum, C., Grabar, S., Mejean, N. & Rey-Salmon, C. 2010 Abusive Head Trauma: Judicial Admissions Highlight Violent and Repetitive Shaking, *Pediatrics*, 126;3;546-555.

Agrawal, S., Peters, M. J., Adams, G. W. & Pierce, C. M. 2012 Prevalence of Retinal Hemorrhages in Critically Ill Children, *Pediatrics*, 129;6;e1388-e1396.

Alexander, R. & Holmgren, B. 2012 SBS and the Supreme Court, *Twelfth International Conference on Shaken Baby Syndrome/Abusive Head Trauma*, National Center on Shaken Baby Syndrome, 29 September-1 October, Boston, MA.  
<http://dontshake.org/conferences.php?conID=17&topNavID=5&&subNavID=39>

Arbogast, K. B., Margulies, S. S. & Christian C. W. 2005 Initial Neurologic Presentation in Young Children Sustaining Inflicted and Unintentional Fatal Head Injuries, *Pediatrics*, 116;1;180-184.

Avril, T. 2007 What Killed Baby Lucas?, *The Inquirer*, 28 October.  
[http://articles.philly.com/2007-10-28/news/24996310\\_1\\_tour-guide-lucas-latin](http://articles.philly.com/2007-10-28/news/24996310_1_tour-guide-lucas-latin)

Bandak, F. A. 2005 Shaken baby syndrome: A biomechanics analysis of injury mechanisms, *Forensic Science International*, 151;1;71-79.

Bandak, F. A. 2006 Shaken baby syndrome: A biomechanics analysis of injury mechanisms [Letter], *Forensic Science International*, 164;2;282-283.

Barnes, P. D. 2011 Imaging of Nonaccidental Injury and the Mimics: Issues and Controversies in the Era of Evidence-Based Medicine, *Radiologic Clinics of North America* 49;1;205-229.

Barnes, P. D., Galaznik, J., Gardner, H. & Shuman, M. 2010 Infant Acute Life-Threatening Event—Dysphagic Choking Versus Nonaccidental Injury, *Seminars in Pediatric Neurology*, 17;1;7-11.

Barry, G. J. & Redleaf, D. L. 2014 *Medical Ethics Concerns in Physical Child Abuse Investigations: A Critical Perspective*, Family Defense Center, Chicago

II.

<http://www.familydefensecenter.net/images/documents/medicalethicspaper.pdf>

Bechtel, K., Stoessel, K., Leventhal, J. M., Ogle, E., Teague, B., Lavietes, S., Banyas, B., Allen, K. et al. 2004 Characteristics That Distinguish Accidental From Abusive Injury in Hospitalized Young Children With Head Trauma, *Pediatrics*, 114;1;165-168.

Block, R. W. 1999 Child Abuse—Controversies and Imposters, *Current Problems in Pediatrics*, 29;9;253-272.

Block, R. W. 2010 SBS/AHT 2010: What We Know, What We Must Learn, What We Must Do to Move Forward, *Eleventh International Conference on Shaken Baby Syndrome/Abusive Head Trauma*, National Center on Shaken Baby Syndrome, 12-14 September, Atlanta GA.

<http://dontshake.org/conferences.php?conID=16&topNavID=5&&subNavID=39>

Boeri, D. 2011 Anatomy of a Bad Confession, Part 1, WBUR Boston Public Radio, 7 December.

<http://www.wbur.org/2011/12/07/worcester-coerced-confession-i>

Brammer, D. 2013 *Edges of Truth: The Mary Weaver Story*, CreateSpace, Hollister CA.

Brown, J. K. & Minns, R. A. 1993 Non-Accidental Head Injury, With Particular Reference to Whiplash Shaking Injury & Medico-legal Aspects, *Developmental Medicine & Child Neurology*, 35;10;849-869.

Caffey, J. 1946 Multiple Fractures in the Long Bones of Infants Suffering From Chronic Subdural Hematoma, *American Journal of Roentgenology and Radium Therapy*, 56;2;163-173.

Caffey, J. 1972 On the Theory and Practice of Shaking Infants: Its Potential Residual Effects of Permanent Brain Damage and Mental Retardation, *American Journal of Diseases of Children*, 124;2;161-169.

Caffey, J. 1974 The Whiplash Shaken Infant Syndrome: Manual Shaking by the Extremities With Whiplash-Induced Intracranial and Intraocular Bleedings, Linked With Residual Permanent Brain Damage and Mental Retardation, *Pediatrics*, 54;4;396-403.

Candler, L. 2013 After Innocence: Julie Baumer Wrongly Convicted of Child Abuse, part of the series After Innocence Exoneration in America WUNC North Carolina Public Radio 11 June.

<http://wunc.org/post/after-innocence-julie-baumer-wrongly-convicted-child-abuse>

Carty, H. & Ratcliffe, J. 1995 The Shaken Infant Syndrome, *British Medical Journal*, 310;6976;344-345.

Case, M. E., Graham, M. A., Handy, T. C., Jentzen, J. M., Monteleone, J. A. & National Association of Medical Examiners Ad Hoc Committee on Shaken Baby Syndrome 2001 Position Paper on Fatal Abusive Head Injuries in Infants and Young Children, *The American Journal of Forensic Medicine & Pathology*, 22;2;112-122.

Case, M. E. 2002 Author's Response, *The American Journal of Forensic Medicine and Pathology*, 23;1;105-106.

Cavazos v. Smith (2011) 132 S. Ct. 2.  
<http://www.supremecourt.gov/opinions/11pdf/10-1115.pdf>

Chadwick, D. L., Bertocci G., Castillo, E., Frasier, L., Guenther, E., Hansen, K., Herman, B. & Krous, H. F. 2008 Annual Risk of Death Resulting From Short Falls Among Young Children: Less Than 1 in 1 Million, *Pediatrics*, 121;6;1213-1224.

Chadwick D. L., Chin, S., Salerno, C., Landsverk, J. & Kitchen, L. 1991 Deaths From Falls in Children: How Far Is Fatal?, *Journal of Trauma*, 31;10;1353-1355.

Chadwick, D., Kirschner, R. H., Reece, R. M., Ricci, L. R. et al. 1998 Shaken Baby Syndrome—A Forensic Pediatric Response, *Pediatrics*, 101;2;321-323.

Christian, C. W. & Block, R. 2009 Abusive Head Trauma in Infants and Children, *Pediatrics*, 123;5;1409-1411.

Committee on Child Abuse & Neglect, American Academy of Pediatrics 1993 Shaken Baby Syndrome: Inflicted Cerebral Trauma, *Pediatrics*, 92;6;872-875.

Committee on Child Abuse & Neglect, American Academy of Pediatrics 2001 Shaken Baby Syndrome: Rotational Cranial Injuries—Technical Report, *Pediatrics*, 108;1;206-210.

Cory, C. Z. & Jones, M. D. 2003 Can Shaking Alone Cause Fatal Brain Injury? A Biomechanical Assessment of the Duhaime Shaken Baby Syndrome Model, *Medicine, Science & the Law*, 43;4;317-333.

De Leeuw, M., Beuls, E., Jorens, P., Parizel, P. & Jacobs, W. 2013 Delta-storage pool disease as a mimic of abusive head trauma in a 7-month-old baby: A case report, *Journal of Forensic & Legal Medicine*, 20;5;520-521.

Del Prete v. Thompson (2014) U.S. District Court for the Northern District of Illinois Eastern Division.  
[http://scholar.google.com/scholar\\_case?case=10740181522360948010&hl=en&as\\_sdt=2006](http://scholar.google.com/scholar_case?case=10740181522360948010&hl=en&as_sdt=2006)

Denton, S. & Mileusnic, D. 2003 Delayed Sudden Death in an Infant Following an Accidental Fall: A Case Report With Review of the Literature, *The American Journal of Forensic Medicine & Pathology*, 24;4;371- 376.

Donohoe, M. 2003 Evidence-Based Medicine and Shaken Baby Syndrome, Part I: Literature Review, 1966-1998, *The American Journal of Forensic Medicine & Pathology*, 24;3;239-242.

Duhaime, A. C., Gennarelli, T. A., Thibault, L. E., Bruce, D. A., Margulies, S. S. & Wiser, R. 1987 The Shaken Baby Syndrome: A Clinical, Pathological, and Biomechanics Study, *Journal of Neurosurgery*, 66;409;409-415.

Duhaime, A. Christian, C.W. Rorke, L.B. & Zimmerman, R. 1998 A nonaccidental head injury in infants—the “shaken baby syndrome.” *New England Journal of Medicine*. 338;1822–1829.  
<http://www.nejm.org/doi/full/10.1056/nejm199806183382507>

Eisenbrey, A. B. 1979 Retinal Hemorrhage in the Battered Child, *Child's Brain*, 5;1;40-44.

Frank, Y., Zimmerman, R. & Leeds, N. M. D. 1985 Neurological Manifestations in Abused Children Who Have Been Shaken, *Developmental Medicine & Child Neurology*, 27;3;312-316.

Geddes, J. F., Hackshaw, A. K. , Vowles, G. H., Nickols, C. D. & Whitwell, H. L. 2001 Neuropathology of Inflicted Head Injury in Children: I. Patterns of Brain Damage, *Brain*, 124;7;1290-1298.

Geddes, J. F., Hackshaw, A. K., Vowles, G. H., Nickols, C. D. & Whitwell, H. L. 2001 Neuropathology of Inflicted Head Injury in Children: II. Microscopic Brain Injury in Infants, *Brain*, 124;7;1299-1306.

Geddes, J. F., Tasker, R. C., Hackshaw, A. K., Nickols, C. D., Adams, G. G. W., Whitwell, H. L. & Scheimberg, I. 2003 Dural Haemorrhage in Non-Traumatic Infant Deaths: Does It Explain the Bleeding in ‘Shaken Baby Syndrome’?, *Neuropathology & Applied Neurobiology*, 29;1;14-22.

Giardino, A. P., Hanson, N., Hill, K. S., & Leventhal, J. M. 2011 Child Abuse Pediatrics: New Specialty, Renewed Mission, *Pediatrics*, 128;1;156-159.

Gilkes, M. J. & Mann, T. P. 1967 Fundi of Battered Babies [Letter], *The Lancet*, 290;7513;468-469.

Gill, J. R., Goldfeder, L. B., Armbrustmacher, V., Coleman, A., Mena, H. & Hirsch, C. S. 2009 Fatal Head Injury in Children Younger Than 2 Years in New York City and an Overview of the Shaken Baby Syndrome, *Archives of Pathology & Laboratory Medicine*, 133;4;619-627.

Greeley, C. 2011 Deconstructing Donohoe. *Third International Conference on Pediatric Abusive Head Trauma*, Penn State Milton S. Hershey Medical Center, 7-8 July, San Francisco CA.

Greeley, C. 2012 A Wolf in Sheep's Clothing: Denialism in Child Abuse Pediatrics. *Twelfth International Conference on Shaken Baby Syndrome/Abusive Head Trauma*, National Center on Shaken Baby Syndrome, 29 September- 1 October, Boston, MA.  
<http://dontshake.org/conferences.php?conID=17&topNavID=5&&subNavID=39>

Greeley, C. S. 2014 "Shaken Baby Syndrome" and Forensic Pathology, *Forensic Science, Medicine & Pathology*. 10;2;253-255.

Guthkelch, A. N. 1953 Subdural Effusions in Infancy: 24 Cases, *British Medical Journal*, 1;4804;233-239.

Guthkelch, A. N. 1971 Infantile Subdural Haematoma and Its Relationship to Whiplash Injuries, *British Medical Journal*, 2;5759;430-431.

Harding, B., Risdon, R. A. & Krous, H. F. 2004 Shaken Baby Syndrome: Pathological Diagnosis Rests on the Combined Triad, Not on Individual Injuries, *British Medical Journal*, 328;7442;720-721.

Holmgren, B. 2010 To Tell the Truth – Examining Defense Witness Testimony in Abusive Head Trauma Cases. *Eleventh International Conference on Shaken Baby Syndrome/Abusive Head Trauma*, National Center on Shaken Baby Syndrome, 12-14 September, Atlanta GA.

<http://dontshake.org/conferences.php?conID=16&topNavID=5&&subNavID=39>

Holmgren, B. K. 2013 Ethical Issues in Forensic Testimony Involving Abusive Head Trauma, *Academic Forensic Pathology*, 3;3;317-328.

Huntington, R. W. 2002 Symptoms Following Head Injury [Letter], *The American Journal of Forensic Medicine & Pathology*, 23;1;105.

Jenny, C. 2005 Report to the Middlesex County District Attorney Office Cambridge Massachusetts, *Commonwealth v. Ann Power*, 29 December.

Jenny, C., Shams, T., Rangarajan, N. & Fukuda, T. 2002 Development of a Biofidelic 2.5 kg Infant Dummy and Its Application to Assessing Infant Head Trauma During Violent Shaking. *Injury Biomechanics Research: Thirtieth International Workshop*, National Highway Traffic Safety Administration/National Transportation Biomechanics Research Center, 10 November, Ponte Vedra Beach, FL.

Joffe, M. & Ludwig, S. 1988 Stairway Injuries in Children, *Pediatrics*, 82;3;457-461.

Kempe, C. H., Silverman, F. N., Steele, B. F., Droegemueller, W. & Silver, H. K. 1962 The Battered-Child Syndrome, *Journal of the American Medical Association*, 181;17;17-24.

Kirschner, R. H. & Wilson, H. L. 1994 Fatal Child Abuse: The Pathologist's Perspective, in Reece, RM, ed. *Child Abuse: Medical Diagnosis & Management*, 325-357, Philadelphia, PA, Lea & Febiger.

Lantz, P. E. & Couture, D. E. 2011 Fatal Acute Intracranial Injury, Subdural Hematoma, and Retinal Hemorrhages Caused by Stairway Fall\*, *Journal of Forensic Sciences*, 56;6;1648-1653.

Lloyd, J., Willey, E. N., Galaznik, J. G., Lee, W. E., & Luttner, S. E. 2011 Biomechanical Evaluation of Head Kinematics During Infant Shaking Versus Pediatric Activities of Daily Living, *Journal of Forensic Biomechanics*, 2;e1-e9.

<http://www.omicsonline.com/open-access/2090-2697/2090-2697-2-109.pdf>

Ludwig, S. & Warman, M. 1984 Shaken Baby Syndrome: A Review of 20 Cases, *Annals of Emergency Medicine*, 13;2;104-107.

Luttner S. 2011 Surviving Justice [Blog entry], *On SBS*, 30 November.

<http://onsbs.com/2011/11/30/surviving-justice/>

Luttner, S. 2012 Witnessed Shaking: Reports and Reflections [Blog entry], *On SBS*, 6 November.

<http://onsbs.com/2012/11/06/witnessed-shaking-in-the-news-and-in-the-past/>

Lyall, S. 1997 Au Pair's Hometown Celebrates Release, *The New York Times*, 11 November.

<http://www.nytimes.com/1997/11/11/us/au-pair-s-hometown-celebrates-release.html>

Lyons, T. J. & Oates, R. K. 1993 Falling out of Bed: A Relatively Benign Occurrence, *Pediatrics*, 92;1;125-127.

Maguire, S. A., Kemp, A. M., Lumb, R. C. & Farewell, D. M. 2011 Estimating the Probability of Abusive Head Trauma: A Pooled Analysis, *Pediatrics*, 128;3;e550-e564.

Margulies, S., Prange, M., Myers, B. S., Maltese, M. R., Ji, S., Ning, X., Fisher, J., Arbogast, K. et al. 2006 Shaken Baby Syndrome: A Flawed Biomechanical Analysis [Letter], *Forensic Science International*, 164;2;278-279.

Molina, D. K. 2009 Neck Injuries and Shaken Baby Syndrome, *The American Journal of Forensic Medicine & Pathology*, 30;1;89-90.

Moreno, J. A. & Holmgren, B. 2013 Dissent Into Confusion: The Supreme Court, Denialism, and the False "Scientific" Controversy Over Shaken Baby Syndrome, *Utah Law Review*, 2013;1;1-54.

<http://epubs.utah.edu/index.php/ulr/article/view/1092/805>

Nashelsky, M. B. & Dix, J. F. 1995 The Time Interval Between Lethal Infant Shaking and Onset of Symptoms: A Review of the Shaken Baby Syndrome Literature, *The American Journal of Forensic Medicine & Pathology*, 16;2;154-157.

National Registry of Exonerations 2014 *Mary Weaver* [Web page], University of Michigan Law School & Center on Wrongful Convictions at Northwestern

University School of Law

<http://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3954>

Ommaya, A. K., Faas, F. & Yarnell, P. 1968 Whiplash Injury and Brain Damage: An Experimental Study, *Journal of the American Medical Association*, 204;4; 285-289.

Ommaya, A. K., Goldsmith, W. & Thibault, L. 2002 Biomechanics and Neuropathology of Adult and Paediatric Head Injury, *British Journal of Neurosurgery*, 16;3;220-242.

Orient, J. M. 2005 Reflections on “Shaken Baby Syndrome”: A Case Report, *Journal of American Physicians & Surgeons*, 10;2;45-50.

Parrish R 2001 *The Third National Conference on Shaken Baby Syndrome Executive Summary*, National Center on Shaken Baby Syndrome, Ogden UT, 24-27 September.

<http://dontshake.org/conferences.php?conID=3&topNavID=5&&subNavID=39>

Piatt, J. H. 1999 A Pitfall in the Diagnosis of Child Abuse: External Hydrocephalus, Subdural Hematoma, and Retinal Hemorrhages, *Neurosurgery Focus*, 7;4;e1-e7.

Piteau, S. J., Ward, M. G. K., Barrowman, N. J. & Plint, A. C. 2012 Clinical and Radiographic Characteristics Associated With Abusive and Nonabusive Head Trauma: A Systematic Review, *Pediatrics*, 130;2;e1-e9.

Pittman, T. 2003 Significance of a Subdural Hematoma in a Child with External Hydrocephalus, *Pediatric Neurosurgery*, 39;2;57-59.

Plunkett, J. 1998 Restricting the Time of Injury in Fatal Inflicted Head Injuries [Letter], *Child Abuse & Neglect*, 22;10;943-944.

Plunkett, J. 1999 Shaken Baby Syndrome and the Death of Matthew Eappen: A Forensic Pathologist’s Response, *The American Journal of Forensic Medicine & Pathology*, 20;1;17-21.

Plunkett, J. 2001 Fatal Pediatric Head Injuries Caused by Short-Distance Falls, *The American Journal of Forensic Medicine & Pathology*, 22;1;1-12.

Prange, M. T., Coats, B. C., Duhaime, A. C. & Margulies, S. S. 2003 Anthropomorphic Simulations of Falls, Shakes, and Inflicted Impacts in Infants, *Journal of Neurosurgery*, 99;1;143-150.

Rangarajan, N. & Shams, T. 2006 Shaken Baby Syndrome: A Biomechanics Analysis of Injury Mechanisms [Letter], *Forensic Science International*, 164;2;280-281.

Ruelas, R. 2012 New Doubts in “Shaken Baby” Fatalities, *The Republic*, 15 September.  
<http://www.azcentral.com/news/articles/20120904shaken-baby-fatalities-doubts.html>

Scheimberg, I., Cohen, M. C., Zapata Vazquez, R. E., Dilly, S., Adnani, M. A., Turner, K. & Sethuraman, C. 2012 Nontraumatic Intradural and Subdural Hemorrhage and Hypoxic Ischemic Encephalopathy in Fetuses, Infants, and Children up to Three Years of Age: Analysis of Two Audits of 636 Cases from Two Referral Centers in the United Kingdom, *Pediatric & Developmental Pathology*, 16;3;149-159.

Seeman, E. Delman, P. D. 2006 Bone Quality: The Material and Structural Basis of Bone Strength and Fragility, *New England Journal of Medicine*, 354;21;2250-2261.

Shapiro, J. 2012 Dismissed Case Raises Question on Shaken Baby Diagnosis, part of the series *Post Mortem: Death Investigation in America*, National Public Radio 21 December.  
<http://www.npr.org/2012/12/21/167719033/dismitted-case-raises-questions-on-shaken-baby-diagnosis>

Slovis, T. L., Strouse, P. J., Coley, B. D. & Rigsby, C. K. 2012 The Creation of Non-Disease: An Assault on the Diagnosis of Child Abuse, *Pediatric Radiology*, 42;8;1-3.

Snoek, J. W., Minderhoud, J. M. & Wilmink, J. T. 1984 Delayed Deterioration Following Mild Head Injury in Children, *Brain*, 107;15-36.

Squier, W. 2011, The “Shaken Baby” Syndrome: Pathology and Mechanisms, *Acta Neuropathologica*, 122;5;519-542.

Squier, W. & Mack, J. 2009 The Neuropathology of Infant Subdural Haemorrhage, *Forensic Science International*, 187;6-13  
State v. Edmunds (2008) 746 N.W. 2d 590.

Stray-Pedersen, A., Omland, S. Nedregard, B., Klevberg, S. & Rognum, T. O. 2011 An Infant With Subdural Hematoma and Retinal Hemorrhages: Does Von Willebrand Disease Explain the Findings?, *Forensic Science, Medicine, & Pathology*, 7;1;37-41.

Sutherly, B. 2005 Cleared Mom Wants to Regain Kids, *Dayton Daily News*, 1 February.

<http://www.highbeam.com/doc/1P2-11934294.html>

Talbert, D. G. 2005 Paroxysmal Cough Injury, Vascular Rupture, and 'Shaken Baby Syndrome,' *Medical Hypotheses*, 64;1;8-13.

Talbert D. G. 2009 Cyclic vomiting syndrome: Contribution to dysphagic infant death, *Medical Hypotheses*, 73:4;473-478.

Talbert, D. G. 2012 Is "Shaken Baby Syndrome" The Malignant Peak of a "Benign Hydrocephalus of Infancy" Iceberg?, *Journal of Trauma & Treatment*, 1;8;1-6.

<http://www.omicsgroup.org/journals/2167-1222/2167-1222-1-149.digital/2167-1222-1-149.html>

Thompson, A. C., & Lee, C. 2011 "The Hardest Cases: When Children Die, Justice Can Be Elusive," part of the series *Post Mortem: Death Investigation in America*, ProPublica 27 June.

<http://www.propublica.org/article/the-hardest-cases-when-children-die-justice-can-be-elusive>

Tuerkheimer, D. 2009 The Next Innocence Project: Shaken Baby Syndrome and the Criminal Courts, *Washington University Law Review*, 87;1;1-58

<http://ssrn.com/abstract=1354659>

Tuerkheimer, D. 2011 Science-Dependent Prosecution and the Problem of Epistemic Contingency: A Study of Shaken Baby Syndrome, *Alabama Law Review*, 62;3;513-569.

[http://www.law.ua.edu/pubs/lrarticles/Volume%2062/Issue%203/TUERKHEIMER-Science-Dependent\\_Prosecution.pdf](http://www.law.ua.edu/pubs/lrarticles/Volume%2062/Issue%203/TUERKHEIMER-Science-Dependent_Prosecution.pdf)

Tuerkheimer, D. 2014, *Flawed Convictions: "Shaken Baby Syndrome" and the Inertia of Injustice*, Oxford University Press USA.

Tung, G. A., Kumar M., Richardson, R. C., Jenny, C. & Brown, W. D. 2006 Comparison of Accidental and Nonaccidental Traumatic Head Injury in Children on Noncontrast Computed Tomography, *Pediatrics*, 118;2;626-633.

Virtanen, M. 2014 NYS Court of Appeals overturns Adrian Thomas' murder conviction, *The Record News*, 20 February.

<http://www.troyrecord.com/general-news/20140221/nys-court-of-appeals-overturns-adrian-thomas-murder-conviction>

Willman, K. Y., Bank, D. E., Senac, M. & Chadwick, D. L. 1997 Restricting the Time of Injury in Fatal Inflicted Head Injuries, *Child Abuse & Neglect*, 21;10;929-940.